

THEREFORE WHAT IS CLAIMED IS:

1. A method of producing a complete monolayer on a substrate having a hydrophilic surface, comprising the steps of:
 - a) pre-treating a surface of a substrate having a hydrophilic surface to remove impurities therefrom; and
 - b) exposing the hydrophilic surface to a fluid comprising a mixture of molecules which can self-assemble on the hydrophilic surface and hydrophobic molecules for a sufficient length of time so that the molecules which can self-assemble on the hydrophilic surface form a complete self-assembled monolayer.
2. The method according to claim 1 wherein the step b) of exposing the hydrophilic surface of the substrate to the fluid includes spin coating the hydrophilic surface with the fluid in contact therewith, including adjusting spin speed.
3. The method according to claim 1 or 2 including adjusting relative humidity (RH), concentration of the molecules of which can self-assemble.
4. The method according to claim 1, 2 or 3 wherein the fluid is a liquid dispersion containing the molecules which can self-assemble and the hydrophobic molecules in which the substrate is immersed.
5. The method according to claim 1, 2 or 3 wherein the fluid is an aerosol containing a liquid dispersion containing the molecules which can self-assemble and the hydrophobic molecules.
6. The method according to claim 1, 2, 3, 4 or 5 wherein the substrate having a hydrophilic surface is mica, and wherein the molecules which can self-assemble are molecules of octadecylphosphonic acid, and wherein the hydrophobic solvent is chloroform or trichloroethylene.

7. The method according to claim 1, 2, 3, 4 or 5 wherein the substrate having a hydrophilic surface is selected from the group consisting of mica, silicon and aluminum, and wherein the molecules which can self-assemble are molecules of octadecylphosphonic acid, and wherein the hydrophobic solvent is chloroform or trichloroethylene.
8. The method according to claim 1, 2, 3, 4 or 5 wherein the substrate having a hydrophilic surface is selected from the group consisting of crystalline solids, polycrystalline solids, amorphous solids and glassy solids.
9. The method according to claim 1, 2, 3, 4 or 5 wherein the substrate having a hydrophilic surface is selected from the group consisting of semiconductors, semimetals, metals and insulators.
10. The method according to claim 1, 2, 3, 4, 5, 6, 7, 8 or 9 wherein the hydrophobic solvent is selected from the group consisting of normal alkanes including hexane, heptane, decane, mixtures of light petroleum napthas, carbon tetrachloride and cyclohexane.
11. The method according to any one of claims 1 to 10 wherein the step of pre-treating the surface includes exposing the surface to ultra-violet light and/or ozone.
12. The method according to any one of claims 1 to 11 including functionalizing the molecules forming the self-assembled monolayer with pre-selected moieties.
13. The method according to any one of claims 1 to 12 wherein the molecules which can self-assemble on the hydrophilic surface are selected so that the complete monolayer is a hydrophobic layer.
14. The method according to any one of claims 1 to 13 wherein the substrate is a wing of an aircraft and the hydrophobic monolayer is an anti-icing layer.

15. The method according to claim 14 wherein the substrate is made of aluminum or an aluminum alloy.
16. The method according to claim 1 wherein the step b) of exposing the hydrophilic surface of the substrate to the fluid includes spin coating the hydrophilic surface with the liquid dispersion in contact therewith, including adjusting spin speed, and wherein the molecules which can self-assemble are molecules of octadecylphosphonic acid, and wherein the hydrophobic solvent is chloroform or trichloroethylene, and wherein the substrate is selected from the group consisting of mica, aluminum, alumina and silicon
17. A method of producing a monolayer with controlled coverage on a substrate having a hydrophilic surface, comprising the steps of:
 - a pre-treating a surface of a substrate having a hydrophilic surface to remove impurities therefrom; and
 - b) exposing the hydrophilic surface to a fluid comprising a mixture of molecules which can self-assemble on the hydrophilic surface and hydrophobic molecules for a sufficient length of time so that the molecules which can self-assemble on the hydrophilic surface form a complete self-assembled monolayer; and
 - c) adjusting relative humidity (RH), concentration of the molecules which can self-assemble and exposure time of the substrate to the fluid to give a monolayer with a selected percentage coverage of the hydrophilic surface.
18. The method according to claim 17 wherein the step b) of exposing the hydrophilic surface of the substrate to the fluid includes spin coating the hydrophilic surface with the liquid dispersion in contact therewith, and including adjusting spin speed during spin coating.
19. The method according to claim 17 wherein the step b) of exposing the hydrophilic surface of the substrate to the fluid includes applying the fluid by misting using an atomizer.

20. The method according to claim 17 wherein the step b) of exposing the hydrophilic surface of the substrate to the fluid includes applying the fluid by forced spreading.
21. The method according to claim 17 wherein the step b) of exposing the hydrophilic surface of the substrate to the fluid includes applying the fluid dipping the substrate into the fluid.
22. The method according to claim 18 wherein the selected percentage coverage of the hydrophilic surface is in a range from about 15% to about 100% coverage is obtained by selectively adjusting spin speed in addition to relative humidity (RH), concentration of the molecules which can self-assemble and exposure time of the substrate to the fluid.
23. The method according to claim 17, 18, 19, 20, 21 or 22 wherein the substrate having a hydrophilic surface is selected from the group consisting of crystalline solids, polycrystalline solids, amorphous solids and glassy solids.
24. The method according to claim 17, 18, 19, 20, 21 or 22 wherein the substrate having a hydrophilic surface is selected from the group consisting of semiconductors, semimetals, metals and insulators.
25. The method according to claim 17, 18, 19, 20, 21 or 22 wherein the substrate having a hydrophilic surface is mica, and wherein the molecules which can self-assemble are molecules of octadecylphosphonic acid, and wherein the hydrophobic solvent is chloroform or trichloroethylene.
26. The method according to claim 17, 18, 19, 20, 21, 22, 23, 24 or 25 wherein the hydrophobic solvent is selected from the group consisting of normal alkanes including hexane, heptane, decane, mixtures of light petroleum napthas, carbon tetrachloride and cyclohexane.

27. The method according to any one of claims 17 to 26 wherein the fluid is a liquid dispersion containing the molecules which can self-assemble and the hydrophobic molecules in which the substrate is immersed.
28. The method according to any one of claims 17 to 26 wherein the fluid is an aerosol containing a liquid dispersion containing the molecules which can self-assemble and the hydrophobic molecules.
29. The method according to any one of claims 17 to 28 wherein the step of pre-treating the surface includes exposing the surface to ultra-violet light and/or ozone.
30. The method according to any one of claims 17 to 29 including functionalizing the molecules forming the self-assembled monolayer with pre-selected moieties.
31. The method according to any one of claims 17 to 30 wherein the molecules which can self-assemble on the hydrophilic surface are selected so that the complete monolayer is a hydrophobic layer.
32. The method according to claim 31 wherein the substrate is a wing of an aircraft and the hydrophobic monolayer is an anti-icing layer.
33. The method according to claim 32 wherein the substrate is made aluminum or an aluminum alloy.
34. A method of producing a complete monolayer on a substrate having a hydrophilic surface, comprising the steps of:
 - a) pre-treating a surface of a substrate having a hydrophilic surface to remove water molecules and/or other impurities; and
 - b) providing a fluid comprising a mixture of molecules which can self-assemble on the hydrophilic surface and hydrophobic molecules, the molecules which can self-assemble having a moiety which seeks a hydrophilic entity, exposing the hydrophilic surface to the fluid for a sufficient length of

time so that the molecules having a moiety which seeks a hydrophilic entity are driven in a presence of the hydrophobic molecules to form a complete self-assembled monolayer.

35. The method according to claim 34 wherein the step b) of exposing the hydrophilic surface of the substrate to the fluid includes spin coating the hydrophilic surface with the liquid dispersion in contact therewith, and including adjusting spin speed during spin coating.

36. The method according to claim 35 wherein the selected percentage coverage of the hydrophilic surface is in a range from about 15% to 100% coverage is obtained by selectively adjusting spin speed in addition to relative humidity (RH), concentration of the molecules which can self-assemble and exposure time of the substrate to the fluid.

37. The method according to claim 34, 35, or 36 wherein the substrate having a hydrophilic surface is selected from the group consisting of crystalline solids, polycrystalline solids, amorphous solids and glassy solids.

38. The method according to claim 34, 35, 36 or 37 wherein the substrate having a hydrophilic surface is selected from the group consisting of semiconductors, semimetals, metals and insulators.

39. The method according to claim 34, 35, 36, 37 or 38 wherein the substrate having a hydrophilic surface is mica, and wherein the molecules which can self-assemble are molecules of octadecylphosphonic acid, and wherein the hydrophobic solvent is chloroform or trichloroethylene.

40. The method according to claim 34, 35, 36, 37, 38 or 39 wherein the hydrophobic solvent is selected from the group consisting of normal alkanes including hexane, heptane, decane, mixtures of light petroleum napthas, carbon tetrachloride and cyclohexane.

41. The method according to claim 34, 35, 36, 37, 38, 39 or 40 wherein the fluid is a liquid dispersion containing the molecules which can self-assemble and the hydrophobic molecules in which the substrate is immersed.
42. The method according to claim 34, 35, 36, 37, 38, 39, 40 or 41 wherein the fluid is an aerosol containing a liquid dispersion containing the molecules which can self-assemble and the hydrophobic molecules.
43. The method according to any one of claims 34 to 42 wherein the step of pre-treating the surface includes exposing the surface to one of ultra-violet light, ozone and a combination of both.
44. The method according to any one of claims 34 to 43 including functionalizing the molecules forming the self-assembled monolayer with pre-selected moieties.
45. The method according to any one of claims 1 to 16 wherein the step b) of exposing the hydrophilic surface to a fluid comprising a mixture of molecules which can self-assemble on the hydrophilic surface and hydrophobic molecules includes exposing the hydrophilic surface to the fluid in at least two consecutive steps.
46. The method according to any one of claim 2 wherein the step b) of exposing the hydrophilic surface to a fluid comprising a mixture of molecules which can self-assemble on the hydrophilic surface and hydrophobic molecules includes exposing the hydrophilic surface to the fluid in at least two consecutive steps, wherein the substrate is spun after each exposure.
47. The method according to any one of claims 17 to 33 wherein the step b) of exposing the hydrophilic surface to a fluid comprising a mixture of molecules which can self-assemble on the hydrophilic surface and hydrophobic molecules includes exposing the hydrophilic surface to the fluid in at least two consecutive steps.

48. The method according to any one of claim 18 wherein the step b) of exposing the hydrophilic surface to a fluid comprising a mixture of molecules which can self-assemble on the hydrophilic surface and hydrophobic molecules includes exposing the hydrophilic surface to the fluid in at least two consecutive steps, wherein the substrate is spun after each exposure.
49. The method according to any one of claims 34 to 44 wherein the step b) of exposing the hydrophilic surface to a fluid comprising a mixture of molecules which can self-assemble on the hydrophilic surface and hydrophobic molecules includes exposing the hydrophilic surface to the fluid in at least two consecutive steps.
50. The method according to any one of claim 35 wherein the step b) of exposing the hydrophilic surface to a fluid comprising a mixture of molecules which can self-assemble on the hydrophilic surface and hydrophobic molecules includes exposing the hydrophilic surface to the fluid in at least two consecutive steps, wherein the substrate is spun after each exposure.
51. A method of patterning a surface of a substrate, comprising the steps of:
- producing a complete monolayer on a substrate having a hydrophilic surface, comprising the steps of
pre-treating a substrate having a hydrophilic surface to remove water molecules and/or other impurities; and
exposing the hydrophilic surface to a fluid having mixture of molecules which can self-assemble on the hydrophilic surface and hydrophobic molecules for a sufficient length of time so that the molecules which can self-assemble on the hydrophilic surface form a complete self-assembled monolayer; and
 - masking the surface with the complete self-assembled monolayer formed thereon to produce a masked portion and an unmasked portion of the surface, altering the molecules forming the self-assembled monolayer in the unmasked portion to produce the pre-selected pattern.

52. The method according to claim 51 wherein the step b) of exposing the hydrophilic surface of the substrate to the fluid includes spin coating the hydrophilic surface with the fluid in contact therewith, including adjusting spin speed.
53. The method according to claim 51 or 52 including adjusting relative humidity (RH), concentration of the molecules of which can self-assemble.
54. The method according to claim 51, 52 or 53 wherein the step of altering the molecules forming the self-assembled monolayer in the unmasked portion includes writing in a pre-selected pattern into the unmasked portion by using an energy beam having sufficient energy to remove, or otherwise alter, the molecules forming the self-assembled monolayer in the unmasked portion to produce the pre-selected pattern.
55. The method according to claim 54 wherein the step of altering the molecules forming the self-assembled monolayer in the unmasked portion includes functionalizing the molecules forming the self-assembled monolayer in the unmasked region with pre-selected moieties.
56. The method according to claim 51, 52, 53, 54 or 55 wherein the fluid is a liquid dispersion containing the molecules which can self-assemble and the hydrophobic molecules in which the substrate is immersed.
57. The method according to claim 51, 52, 53, 54, 55 or 56 wherein the substrate having a hydrophilic surface is selected from the group consisting of crystalline solids, polycrystalline solids, amorphous solids and glassy solids.
58. The method according to claim 51, 52, 53, 54, 55 or 56 wherein the substrate having a hydrophilic surface is selected from the group consisting of semiconductors, semimetals, metals and insulators.